The Pendula of Atomic Collisions

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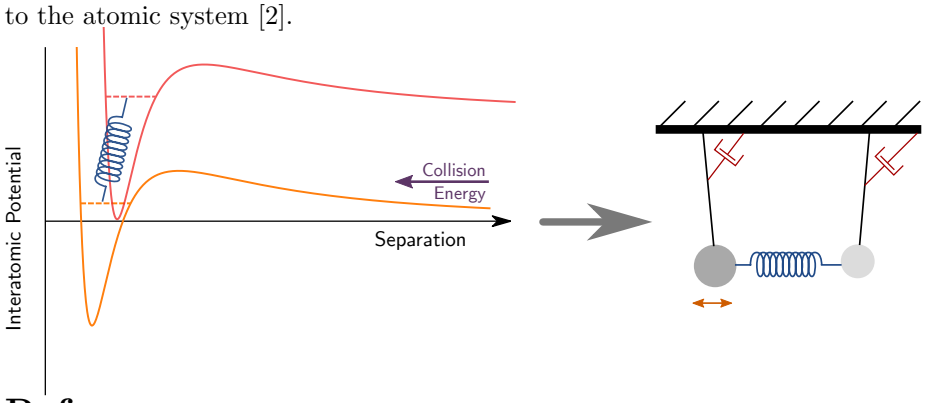
Resonances are ubiquitous in physics, appearing in all manner of classical and quantum systems. A common example is the increase in the amplitude of a pendulum driven near its resonant frequency, and similar resonances occur in a large variety of mechanical, electrical and optical systems. In atomic scattering, resonances manifest as drastically enhanced or suppressed scattering at energies near a quasi-bound state of the system.

We consider the interaction of a Feshbach resonance and a shape resonance as we have observed in collisions of ultracold Rubidium. Previously, we have described the interaction in terms of the avoided crossing of S-matrix poles in the complex energy plane [1]. Here we elaborate upon the measurements, and investigate the situation using the paradigm of quantum defect theory. Quantum defect theory relies on only 6 parameters, yet provides an adequate model for the physical system. In comparison, coupled-channels calculations rely on realistic potentials with more than 40 parameters. We also examine a classical system of two coupled pendula, which, perhaps surprisingly, provides a good analogy to the atomic system [2].



References

[1] Matthew Chilcott, Ryan Thomas, Niels Kjærgaard, *Experimental observation of the avoided crossing of two S-matrix resonance poles in an ultracold atom collider,* arXiv:2103.05278 (2021).

[2] Matthew Chilcott, James F. E. Croft, Ryan Thomas, Niels Kjærgaard, *Observations and models of interacting collisional resonances,* Manuscript in preparation.